

- 1    **1. A method of using an alkali metal vapor cell to determine the modulation index of**  
2    **a frequency-modulated laser source,**  
3    **the method comprising the steps of:**
  - 4           modulating the laser source at a given power and a given frequency;
  - 5           passing the laser light from the modulated laser source through the cell; and
  - 6           determining the modulation index of the laser source from the absorption
  - 7    **spectrum of the alkali metal vapor.**
- 1    **2. The method set forth in claim 1 wherein:**
  - 2           the absorption spectrum includes plurality of minima; and
  - 3           the modulation index is determined from the minima.
- 1    **3. The method set forth in claim 2 wherein:**
  - 2           a photodetector receives the laser light that passes through the cell; and
  - 3           the minima are measured using the output of the photodetector.
- 1    **4. The method set forth in either claim 2 or claim 3 wherein:**
  - 2           in the step of determining the modulation index, the modulation index is
  - 3    **determined using ratios of the minima.**
- 1    **5. The method set forth in claim 4 wherein:**
  - 2           the modulation index is ambiguously determined using a ratio of first ones of
  - 3    **the minima and disambiguated using a ratio of second ones of the minima.**
- 1    **6. The method set forth in claim 4 wherein:**
  - 2           the minima include a primary minimum and a first satellite minimum; and
  - 3           the modulation index is determined using the ratio of the primary minimum
  - 4    **and the first satellite minimum.**
- 1    **7. The method set forth in claim 6 wherein:**
  - 2           the minima include a second satellite minimum and a third satellite minimum;
  - 3           the determination of the modulation index using the ratio of the primary
  - 4    **minimum and the first satellite minimum is ambiguous; and**

5 in the step of determining the modulation index, the ratio of the second  
6 satellite minimum and the third satellite minimum are employed to disambiguate the  
7 modulation index determined using the ratio of the primary minimum and the first  
8 satellite minimum.

1 8. The method set forth in claim 4 wherein:

2 the minima include a first satellite minimum and a second satellite minimum;  
3 and

4 the modulation index is determined using the ratio of the first satellite  
5 minimum and the second satellite minimum.

1 9. The method set forth in claim 8 wherein:

2 the minima include a third satellite minimum;

3 the determination of the modulation index using the ratio of the first satellite  
4 minimum and the second satellite minimum is ambiguous; and

5 in the step of determining the modulation index, the ratio of the second  
6 satellite minimum and the third satellite minimum are employed to disambiguate the  
7 modulation index determined using the ratio of the first satellite minimum and the  
8 second satellite minimum.

1 10. The method set forth in claim 1 wherein:

2 in the step of modulating the laser source, the given frequency is  
3 approximately one half that of the hyperfine separation of the alkali metal vapor in the  
4 cell.

1 11. A method of calibrating a frequency-modulated laser source in a CPT frequency  
2 standard to run at a desired modulation index, the light from the laser source passing  
3 through an alkali metal vapor cell in the CPT frequency source and  
4 the method comprising the steps of:

- 5 1. modulating the laser source at a given power and a given frequency;
- 6 2. determining the modulation index of the laser source from the absorption  
7 spectrum of the alkali metal vapor; and
- 8 3. repeating steps 1-2 with a different given powers until the determined  
9 modulation index is the desired modulation index.

1   **12.** The method set forth in claim 11 further comprising the step of:  
2           operating the laser source thereafter at the given modulation power that  
3   produces the desired modulation index.

1   **13.** The method set forth in claim 12 wherein:  
2           the CPT frequency standard automatically performs the method of claim 12.

1   **14.** The method set forth in claim 13 wherein:  
2           the method is performed upon initialization of the CPT frequency standard.

1   **15.** The method set forth in claim 13 wherein:  
2           the method is performed during normal operation of the CPT frequency  
3   standard.

1   **16.** A CPT frequency standard that includes a frequency-modulated laser source and  
2   an alkali metal vapor cell,  
3   the laser source having been calibrated to operate at a desired modulation index by  
4   performing steps comprising:  
5       1. modulating the laser source at a given power and a given frequency;  
6       2. determining the modulation index of the laser source from the absorption  
7       spectrum of the alkali metal vapor; and  
8       3. repeating steps 1-2 with different given powers until the determined  
9       modulation index is the desired modulation index.

1   **17.** The method set forth in claim 16 further comprising the step of:  
2           operating the laser source thereafter at the given modulation power that  
3   produces the desired modulation index.

1   **18.** The method set forth in claim 17 wherein:  
2           the CPT frequency standard automatically performs the method of claim 17.

1   **19.** The method set forth in claim 18 wherein:

2           the CPT frequency standard automatically performs the method of claim 17  
3   upon initialization.

1   **20.** The method set forth in claim 18 wherein:

2           the CPT frequency standard automatically performs the method of claim 17  
3   during normal operation.

1   **21.** A CPT frequency standard comprising:

2           a frequency-modulated current source for a laser;  
3           an alkali metal vapor cell through which light from the laser passes; and  
4           a control processor that receives a digitized signal that indicates variations in  
5   the amount of light which is transmitted by the vapor cell,  
6   the control processor determining a current modulation index from the digitized signal  
7   and controlling the power of the frequency modulation in the current source to  
8   produce the desired modulation index.

1   **22.** The CPT frequency standard set forth in claim 21 wherein:

2           the control processor controls the power of the frequency modulation in the  
3   current source to produce the desired modulation index upon initialization of the CPT  
4   frequency standard.

1   **23.** The CPT frequency standard set forth in claim 21 wherein:

2           the control processor controls the power of the frequency modulation in the  
3   current source to produce the desired modulation index during normal operation of the  
4   CPT frequency standard.